

the direction of motion in the line joining the centre of disturbance and the point of observation, while the other set has the direction of motion at right angles to that line. The first of these is denominated the direct wave, and the second the transverse wave. The direct wave has a greater amplitude and a slightly shorter period of motion at the source, but seems to die out more rapidly than the transverse wave. The amplitude of the direct vibrations seems never to have exceeded 0.5 millim. at 50 feet, and 0.1 millim. at 250 feet from the centre. The amplitude of vibration was very nearly inversely as the distance from the source. The direct wave was completely cut off by the pond and nearly, if not completely, by the hill, but the transverse wave extended along the distant side of the pond to a considerable distance, and was little affected by the hill. When the motion of a point on the earth's surface was registered by means of a seismograph, it was found to be such as would result from the composition of two harmonic motions of different period, and in different directions. One of the most important points attended to in these experiments was the determination of the velocity of propagation for the different waves. The method finally adopted for this purpose was to mark by means of a telegraphic arrangement, simultaneously, and at definite intervals, on two smoked glass plates, placed at different distances along the same line from the source, the same instant of time. These plates were moved by clockwork, and were used for the reception of the seismograph record.

It is evident that the time-marks on the plate give the means of comparing the times of arrival of the direct, or the transverse wave, according to circumstances at the two stations, and hence, knowing the time-interval between the marks on the plates, the velocity of propagation could readily be calculated.

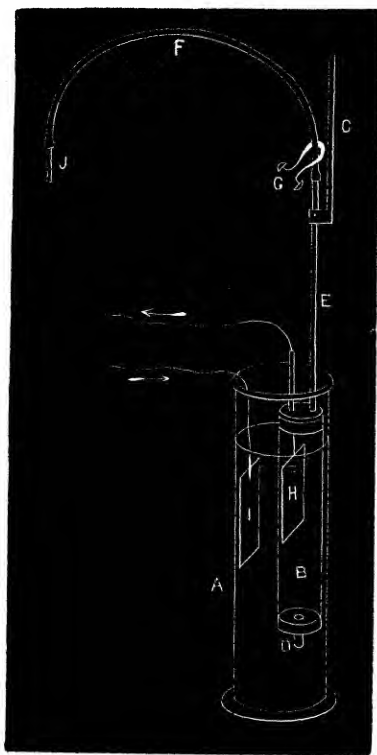
As the result of these observations the surprisingly low velocity of 438 feet per second for the direct, and 357 feet per second for the transverse wave, was obtained. The soft nature of the material through which the disturbance was propagated is given as the probable reason for this result.

The results of similar experiments by Mr. Robert Mallet, at the Hellgate explosions, in New York Harbour, are referred to. At the conclusion of the paper an example of the records obtained in actual earthquakes is given and briefly described.

VIII. "On the Electrolytic Diffusion of Liquids." By G. GORE, LL.D., F.R.S. Received November 8, 1881.

In a paper on the "Influence of Voltaic Currents on the Diffusion of Liquids" ("Proc. Roy. Soc.," vol. 32, 1881), I described a number

of phenomena resulting from the passage of an electric current vertically through the boundary surfaces of mutual contact of two electrolytes lying upon each other. As it was not possible by means of the apparatus employed in that research to definitely ascertain whether the mass of liquid expanded or moved as a whole in the line of the current, I devised the following arrangement for the purpose of more conclusively testing that question, and to obtain additional data to assist in explaining the phenomena previously observed.



A is a glass vessel containing the heavier liquid, B is a glass tube about 15 centims. long and 2 centims. diameter, containing the lighter solution, and capable of being raised and lowered by means of the rack C and a pinion (not shown in the sketch), attached to a fixed upright support. The tube B is closed at the lower end by an india-rubber bung, in a hole in the centre of which is fixed the open glass meniscus tube D, about 16 millims. long, and having a bore of about 6 millims.; it is also closed at the top by a perforated bung, through which proceeds an open glass tube E, of somewhat smaller

diameter than the meniscus tube, and about 15 centims. long. To the upper end of E is attached an india-rubber tube F, provided with a pinch-tap G. H and I are two sheet platinum electrodes, each about 7 centims. long, and 18 millims. wide, for connexion with a voltaic battery. The connecting wire of H is hermetically sealed in a glass tube, which fits air-tight into the bung.

In using this apparatus, the vessel A is shifted from its place, and the heavier liquid poured into it. The tube B is then filled by means of suction at J with the lighter liquid up to a level in E, a little above the bung. The tube F is then closed by means of the pinch-tap G, the vessel A replaced, and B, &c., lowered by means of the rack and pinion until the pressure of liquid in A just balances that in B, the difference of level being approximately determined beforehand, by taking the specific gravities of the two liquids. A definite meniscus is then easily formed in the tube D, by opening the pinch-tap and raising B until a drop of liquid issues below, and then lowering it a minute distance. It is particular that no air bubble exists in B, and in order to facilitate the escape of any, the interior of the upper bung is made of a funnel shape, and coated very smoothly with sealing wax.

In an experiment I made with this apparatus, the heavier liquid was a solution of nitrate of mercury of specific gravity 1.30, and the lighter one a solution of cupric nitrate, specific gravity 1.22. With an upward current from 18 Grove's elements in single series, a colourless horizontal line soon appeared below the meniscus in D, advanced downward, and underflowed the end of the meniscus tube. Neither the meniscus in the lower tube D, nor that in the upper one E, shifted in position during the passage of the current. These results were repeatedly verified with the meniscus at different distances, varying from one-sixteenth to one-eighth of an inch above the bottom of the tube.

*Remarks.*—These results show first, and most conclusively, that liquid diffused downwards continuously through the meniscus during the passage of the upward current; and second, that during the continuance of the current, either no manifest expansion occurred in the bulk of the liquid in B, and that equal volumes of liquid diffused in two opposite directions through the lower meniscus; or, that any expansion of the bulk of liquid in tube B was compensated for by downward diffusion of an equal bulk of liquid. Another possibility is that the united volumes of the metallic deposited copper, and of the acid element from which it had been separated by electrolysis, was greater than before such separation, and that this was compensated for by the volume of liquid diffused downwards through the meniscus.

